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(54) Clamping a coaxial connector to a corrugated cable shield

(57) A plug has a clamp-sleeve (11) for engaging at (111) the first corrugation trough of the corrugated outer conductor (6a) of a coaxial cable and a screw-ring (2) for driving the sleeve. The sleeve (11) has axial slits (115), which allow the end of the sleeve (11) to be compressed onto the conductor (6a) when pressed onto a surface (1a) of the body of the plug (1) by action of the screw ring. Action of the screw ring also clamps the other end of the ring (11) against conductor (6a) by virtue of slits (116) interdigitated with slits (115).

Fig.1

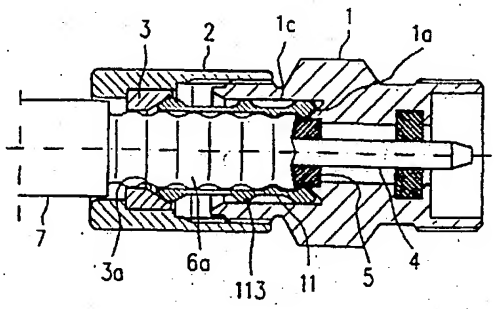

Fig.10

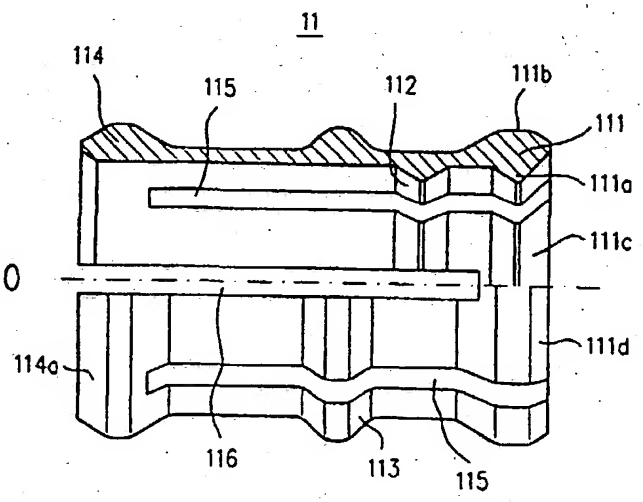

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Fig.1

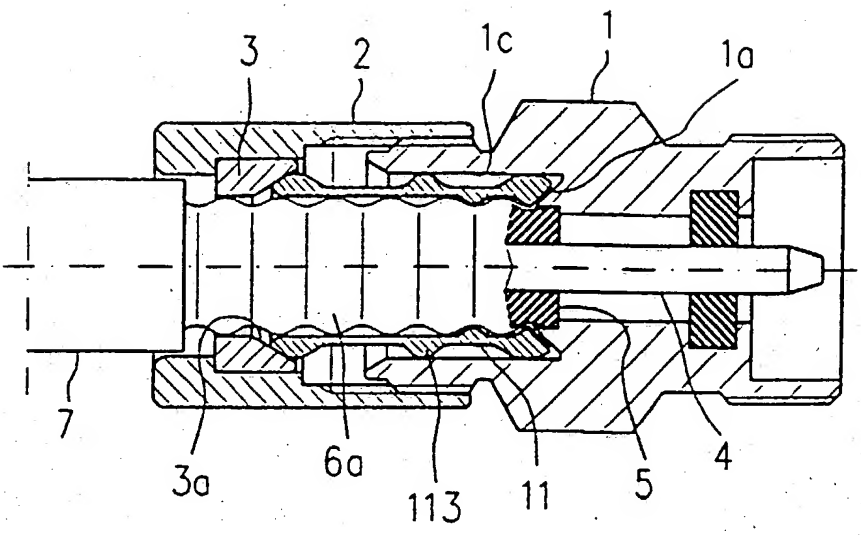


Fig.2

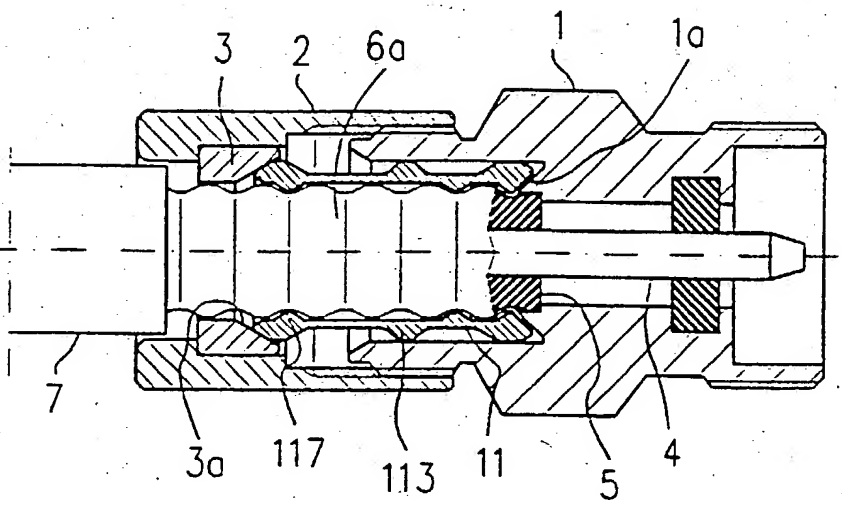


Fig.3

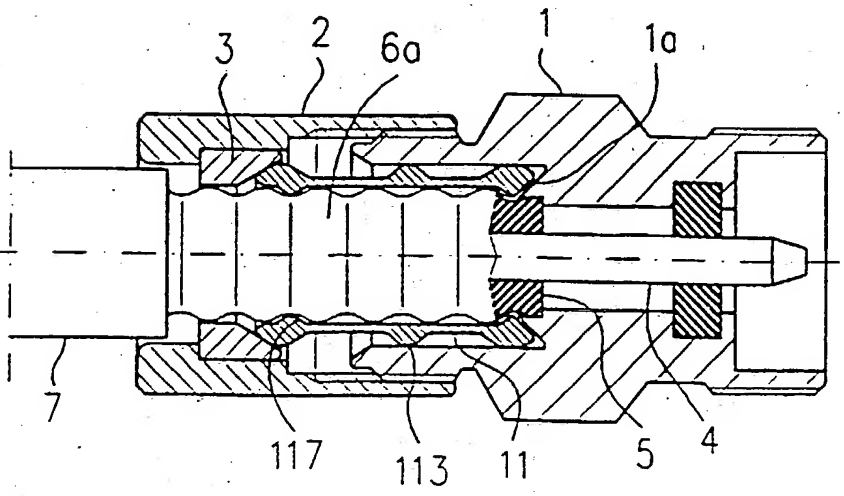


Fig.4

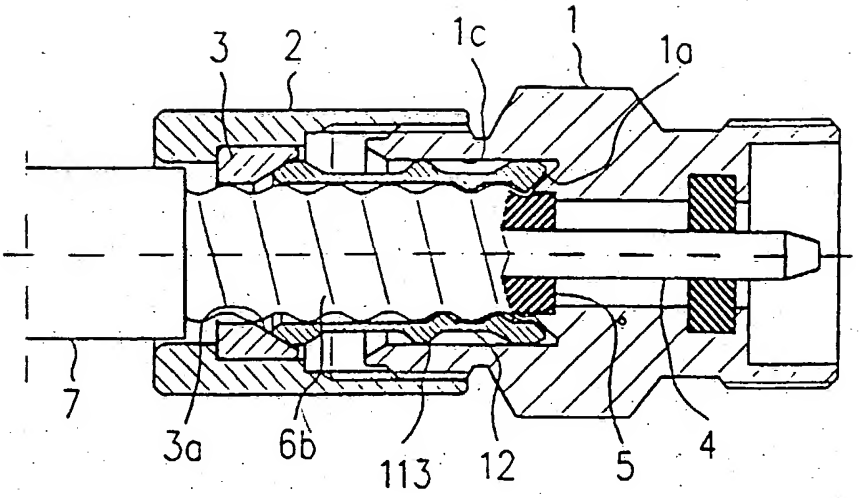


Fig.5

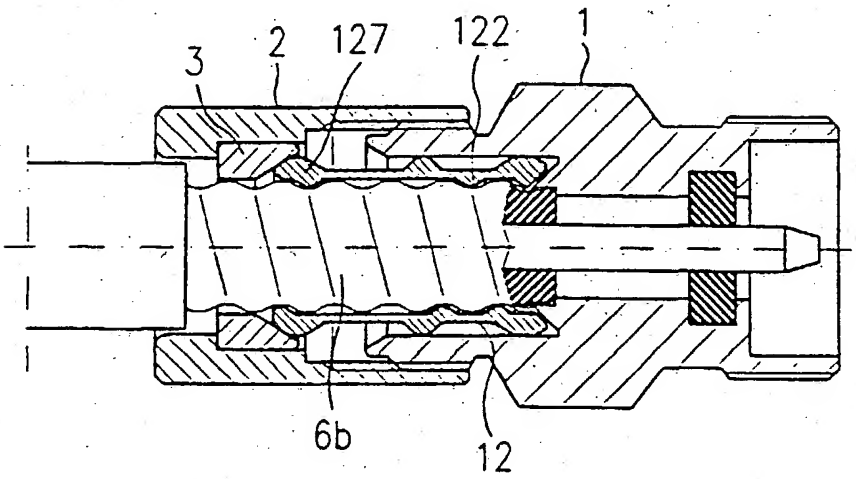


Fig.6

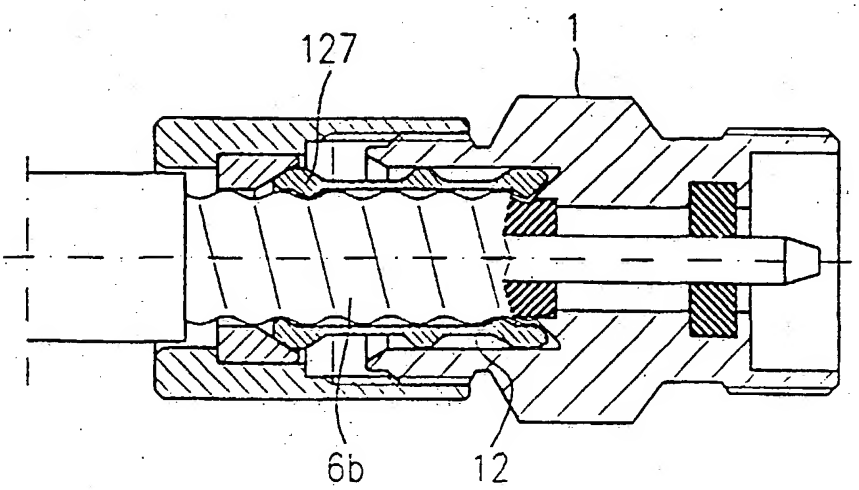


Fig.7

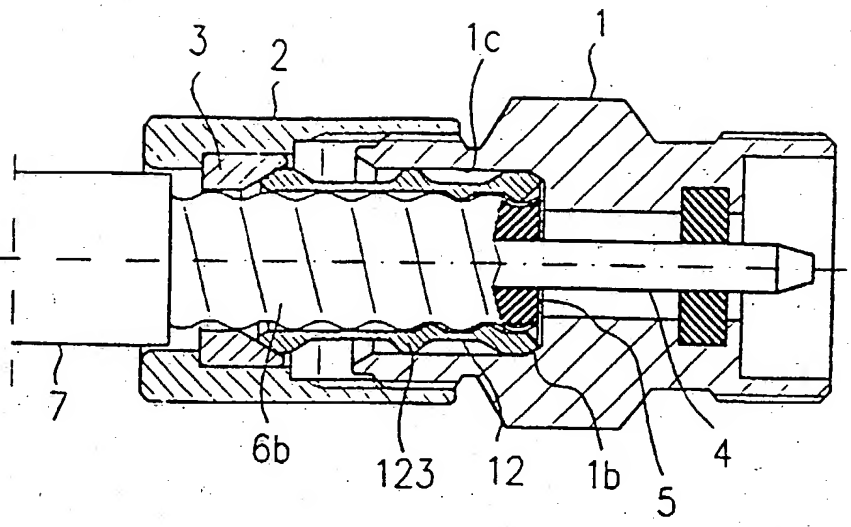


Fig.8

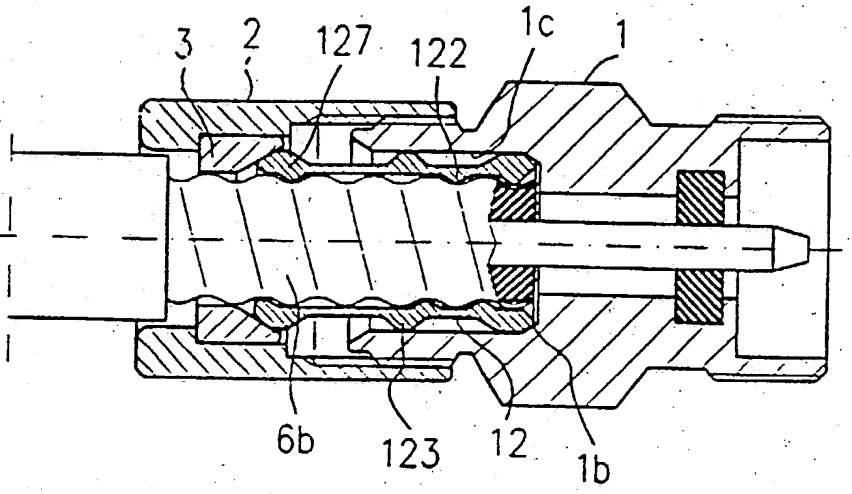


Fig.9

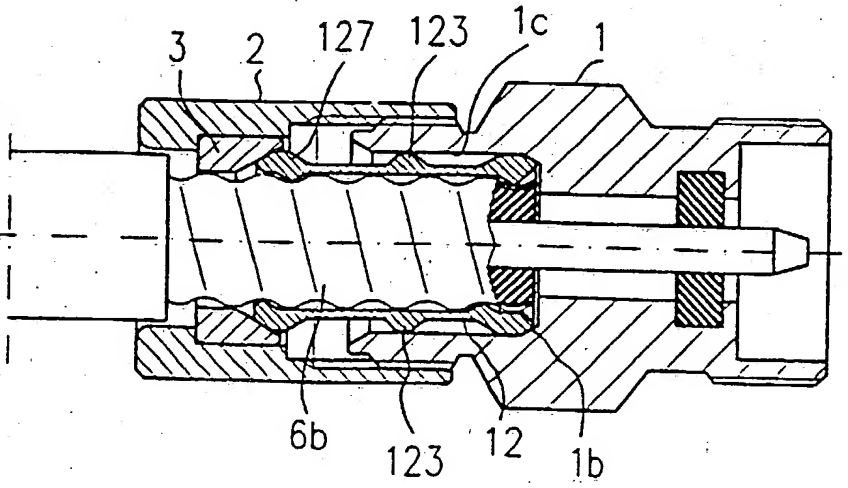


Fig.10

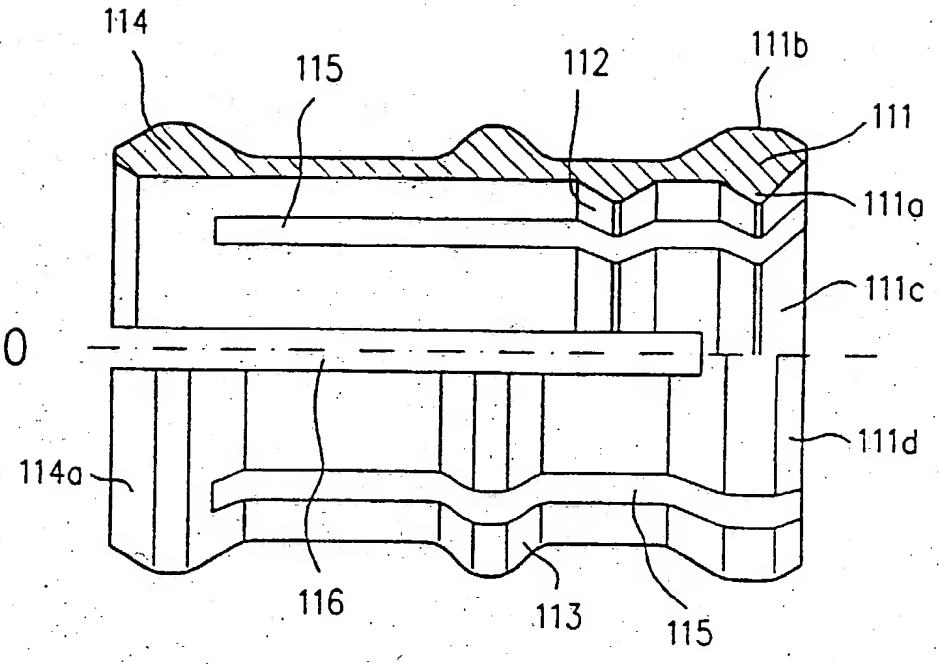
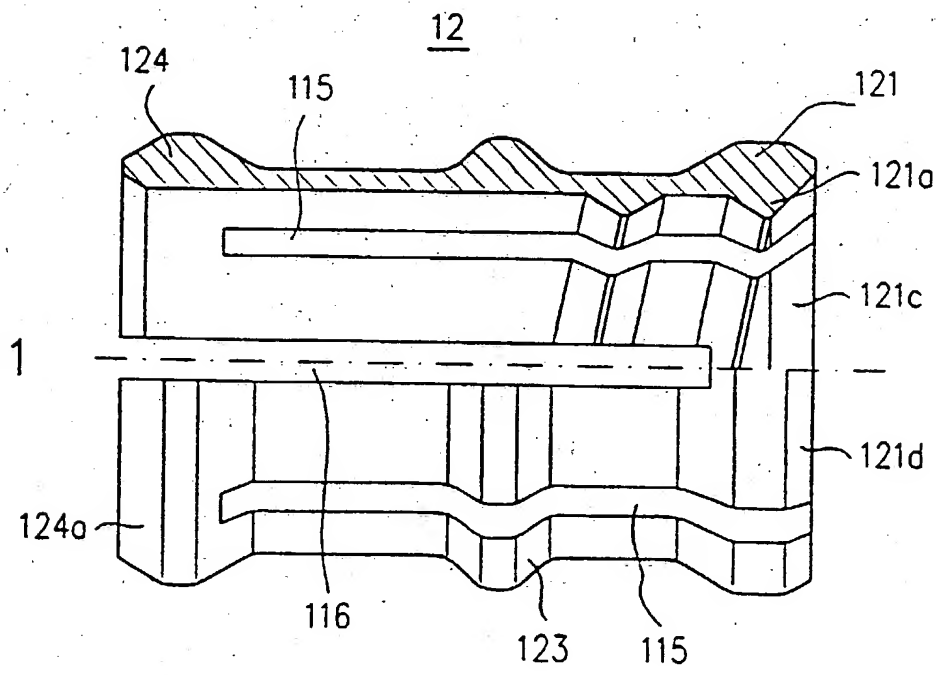

11
114
115
112
111b
111
111a
111c
111d
114a
116
113
115

Fig.11


12
124
115
121
121a
121c
121d
124a
116
123
115

A PLUG-IN CONNECTOR FOR A COAXIAL CABLE WITH A CORRUGATED TUBE OUTER CONDUCTOR

The invention relates to a plug-in connector for a coaxial cable with a corrugated tube outer conductor.

A plug-in connector for this purpose is disclosed in DE-PS 27 24 862 and has intercepting- and contacting sleeve forming one integral structural part together with the thrust member which can be screwed into the connector housing. This is a problem in that when the thrust member is being screwed into the connector housing (or, conversely, when the connector housing is being screwed onto the thrust member suitably positioned on the end of the corrugated tube outer conductor), as the annular edge regions of the front end of the outer conductor become increasingly clamped between the cooperating conical annular faces of the housing and of the bead at the front edge, at the plug-in side, of the sleeve, increasing torsional forces are exerted on the spring segments of the sleeve produced by the axial slits. Since the sleeve segments are greatly deformed in various ways by the effect of the torsional forces acting upon their front edges, the contacting obtained over the periphery of the corrugated tube outer conductor is not uniform. Also, it has been seen that the clamping and bracing of the corrugated tube outer conductor with the connector housing is only insufficient in the region of the front end edge of the corrugated tube, above all in instances when the coaxial cable is exposed to mechanical claims during use and/or where the corrugated tube consists of a relatively soft and therefore plastically deformable copper alloy. Therein, insufficient clamping is synonymous with a contacting which varies in quality along the periphery of the outer conductor, which contacting, in turn, results in the occurrence of intermodulation products in the signal transmitted by way of the plug-in connector. A further drawback which is of great significance practically speaking with the known plug-in connector is the fact that the plug-in connector can only be used for coaxial cables whose outer conductor has an annular corrugation.

According to one aspect of the invention there is provided a plug-in connector for a coaxial cable with a corrugated tube outer conductor, the connector comprising a connector housing which has a

bore to receive the outer conductor, the bore having at the periphery of its base a conical annular surface to contact an inner annular peripheral surface of the front end of the outer conductor; an intercepting- and contacting sleeve to embrace the outer conductor concentrically and having axial slits emanating from its front end edge on the plug-in side, with the front end edge of the intercepting- and contacting sleeve designed as a bead which projects at least radially inwardly and engages in a first corrugation trough of the outer conductor, has a conical clamping surface to rest on an outer annular peripheral surface of the front end of the outer conductor; and rests by way of its outer circumferential face on the inner wall of the bore of the connector housing, and a thrust member which can be screwed to the connector housing and which axially loads the rear end, on the cable side, of the sleeve, in which the sleeve has axial slits emanating from its rear end on the cable side, the slits being uniformly displaced circumferentially opposite the axial slits emanating from the front end edge of the sleeve, and, on the cable side, the sleeve has an end face which is in the form of a tapered annular surface and cooperates with a complementary tapered annular surface which is provided on the front edge of the thrust member radially to compress the rear end of the sleeve when the thrust member is tightened.

Such a plug-in connector can be used both for coaxial cables with helically corrugated outer conductors and also for those with annularly corrugated outer conductors, and can ensure reliable clamping and interception of the outer conductor even when there are high mechanical claims, so that permanent good contacting is obtained uniformly over the periphery of the end edge of the outer conductor, and so that the occurrence of intermodulation products is prevented.

Firstly the intercepting- and contacting sleeve is to be separated from the thrust member, and secondly the rear end of the sleeve, or the end on the cable side, is to be compressed radially until it bears on the next corrugation apex. In this way, it is not only possible to largely avoid circumferential forces acting on the front end edge of the sleeve, but it is possible to prevent relative movement between the corrugated tube outer conductor and the plug-in connector which is unavoidable because of the design and which exists

with the prior art mentioned in the introduction, particularly in the place where the coaxial cable enters the connector housing.

While the plug-in connector is suitable as it is for coaxial cables with annularly corrugated outer conductors, for use with coaxial cables with helically corrugated outer conductors, it is only necessary to adapt the radially inwardly projecting part of the bead on the front end edge of the sleeve to the course of the helical corrugation.

A further improvement to the double clamping of the outer conductor can be obtained if the predominant part of the sleeve is distanced by an annular gap from the inner wall of the bore of the connector housing, but that the sleeve has an annular collar on the outside approximately halfway along its length, by means of which annular collar it bears against the inner wall of the bore of the connector housing. Due to the reduced wall thickness of the segments or vanes formed this permits considerably increased elasticity of the sleeve radially or selectively permits a reduction in the number of segments.

Unlike with the plug-in connector according to the prior art mentioned in the introduction, with the intercepting- and contacting sleeve according to the present proposal, a high degree of radial elasticity is not only possible but particularly preferred. Preferably the axial slits emanating from the front end edge of the sleeve extend to a location in the vicinity of the end, on the cable side, of the sleeve, and the axial slits which emanate from the end, on the cable side, of the sleeve extend to a location in the vicinity of the front end edge of the sleeve. For this embodiment, the sleeve is of low wall thickness, and the annular collar is advantageous by means of which it bears on the inner wall of the bore of the connector housing. This annular collar allows high axial forces to be applied without there being a risk of one or more segments of the sleeve buckling.

Advantageously the thrust member comprises a thrust ring which supports the tapered conical surface and a screw member which form-lockingly receives the thrust ring, the screw member being in threaded engagement with the connector housing. Torsional forces which act upon the sleeve and which are caused by the thrust member being inserted are almost completely avoided.

Preferably the inside of the sleeve has a second bead to engage

into a second corrugation trough of the outer conductor. Thus an additional form-locking connection is produced between the sleeve and the second corrugation trough of the outer conductor (with annularly corrugated outer conductors) or between the sleeve and another thread of the outer conductor (with helically corrugated outer conductors).

Alternatively or in addition in the region of its end at the cable side the inside of the sleeve has a third bead to engage into a corrugation trough of the outer conductor.

The proposed type of interception of the outer conductor in a circumferential region which is distanced axially from the front edge of the outer conductor is mechanically so reliable both with cables with annularly corrugated outer conductors and also with cables with helically corrugated outer conductors that in specific cases an additional mechanical clamping can be abandoned of the end edge region of the outer conductor.

According to another aspect of the invention there is provided a plug-in connector for a coaxial cable with a corrugated tube outer conductor, the connector comprising a connector housing which has a bore to receive the outer conductor, the bore having at the periphery of its base a conical annular surface; an intercepting- and contacting sleeve to embrace the outer conductor concentrically and having axial slits emanating from its front end edge on the plug-in side, with the front end edge of the intercepting- and contacting sleeve designed as a bead which projects at least radially inwardly and engages in a first corrugation trough of the outer conductor and bears by way of its outer circumferential face on the inner wall of the bore of the connector housing; and a thrust member which can be screwed to the connector housing and which loads the rear end, on the cable side, of the sleeve axially, in which the conical annular face on the peripheral base of the bore of the connector housing is oriented in such a way that it cooperates with a complementary tapered annular face provided on the front edge of the bead of the sleeve to radially to compress the bead of the sleeve when the thrust member is tightened, the sleeve has axial slits emanating from its rear end on the cable side which are uniformly displaced circumferentially opposite the axial slits emanating from the front end edge of the sleeve, and on the cable side, the sleeve has an end face which is designed as a tapered conical surface, and cooperates

with a complementary tapered annular surface provided on the front edge of the thrust member to radially to compress the rear end of the sleeve when the thrust member is tightened.

Thus mechanical clamping of the edge of the front end of the outer conductor, wherein the intercepting- and contacting sleeve is subjected to radial expansion in the region of its plug-in side end edge is replaced by a limited radial compression. This radial compression is obtained by having the conical annular surface at the periphery of the base of the bore of the connector housing and the tapered annular surface which is formed at the cable side end of the sleeve so that it is oriented conversely to the corresponding surfaces of the plug-in connector according to the first solution. Without any firm mechanical form-locking connection being necessary therein between the front plug-in side end edge of the sleeve and the corrugation of the outer conductor, the radial compression in that region nonetheless creates uniform electrical contacting over the periphery between the outer conductor and the plug-in end of the sleeve, and also between its front edge and the connector housing.

The plug-in connector according to this second embodiment can be improved in the same way and can be further designed in the way already described in conjunction with the plug-in connector according to the first solution.

The invention is diagrammatically illustrated by way of example with reference to the accompanying drawings, in which:

Figures 1 to 3 show three versions of a plug-in connector according to a first embodiment of the invention, for a cable with an annularly corrugated outer conductor;

Figures 4 to 6 show the same embodiment as Figures 1 to 3, but suitable for a cable with a helically threaded outer conductor;

Figures 7 to 9 show three versions of a plug-in connector according to a second embodiment of the invention, for a cable with a helically threaded outer conductor; and

Figures 10 and 11 show half-sectional drawings on a larger scale of an intercepting- and contacting sleeve shown in Figure 1 and in Figure 4.

Figures 1 to 9 show a plug-in connector which has a connector housing 1, a sleeve for a compression nut in the form of a hollow nut

2 and thrust ring 3. The plug-in connector sits on the end of a coaxial cable with an inner conductor 4, a dielectric 5 and either an outer conductor 6a with an annular thread (Figures 1 to 3) or an outer conductor 6b with a helical thread (Figures 4 to 9), and also a cable casing 7.

The bore of the connector housing 1 which receives the outer conductor 6a or 6b has a conical annular face 1a at the base of its periphery (Figures 1 to 6) or 1b (Figures 7 to 9).

In the embodiment according to Figure 1 the end of the cable outer conductor 6a is embraced by an intercepting- and contacting sleeve 11, the details of which are more clearly visible in Figure 10. The sleeve 11 has a front end edge in the form of a bead 111. This comprises:

- a radially inwardly projecting part 111a by means of which it engages in a first corrugation trough of the outer conductor 6a as shown Figure 1;
- a radially outwardly projecting part 111b, by means of the circumferential surface of which it rests against an inner wall 1c of the bore of the connector housing 1 as shown in Figure 1; and
- a conical clamping surface 111c which has the same orientation as the conical annular surface 1a of the connector housing 1.

An annular end edge region of the outer conductor 6a is firmly clamped and contacted between the conical annular faces 111c and 1a by the effects of the hollow nut 2 and of the thrust member 3. In the case of an annularly threaded outer conductor it is therefore important for the sectional plane, ie the position at which it is cut off, to be disposed such that it extends approximately through the apex of the corrugation, see Figure 1.

At a spacing of one corrugation from the bead 111 the sleeve 11 has a second bead 112 which projects only radially inwardly and which engages into the second corrugation trough of the outer conductor 6a, as shown in Figure 1.

About halfway along its length the sleeve 11 has a peripheral radially outwardly projecting annular collar 113 by means of which it bears, as shown in Figure 1, on the inner wall 1c of the bore of the

connector housing 1.

At the rear end, on the cable side, of the sleeve 11 there is a radially outwardly oriented region 114 of increased thickness, on which a tapered annular surface 114a is formed, which cooperates with a complementary tapered annular surface 3a provided on the front edge of the thrust member 3 as shown in Figure 1, radially to compress the rear end of the sleeve 11 when the hollow nut 2 is tightened.

Finally, the sleeve 11 has a plurality of axial slits 115 emanating from its front bead 111, which slits 115 are uniformly distributed circumferentially and extend as far as the region 114 of increased thickness of the sleeve 11. Similar slits 116 extend from the rear edge of the sleeve 11 as far as the bead 111, and are arranged in alternating relationship circumferentially with the slits 115. The segmenting of the sleeve 11, caused by the slits 115 and 116, imparts to the sleeve a high degree of radial elasticity which is dependent on the number of slits and on the material of which the sleeve is made and on the strength of that material.

The axial length of the sleeve 11 is such that the inner wall thereof preferably rests on a corrugation apex in the region of its rear end, on the cable side. When the hollow nut 2 is tightened, the rear end of the sleeve 11 is therefore radially compressed by the thrust ring 3, and the outer conductor 6a is firmly clamped in that region. At the same time, an axial thrust is applied to the sleeve 11, which effects the mechanical clamping and electrical contacting of the front edge of the outer conductor 6a, wherein the sleeve 11 bears by way of its annular collar 113 against the inner wall 1c of the bore of the connector housing 1, so that not only is/are the sleeve 11, or individual segments of the sleeve, prevented from buckling, but also a toggle joint type effect is simultaneously produced.

The plug-in connector according to Figure 2 differs from that in Figure 1 simply in that the sleeve 11 is provided in the region of its rear end with a third bead 117 which engages in a corrugation trough of the outer conductor 6a, so that in that region a still further improved form-locking connection is produced.

The plug-in connector according to Figure 3 differs from that in Figure 1 in that although the sleeve 11 admittedly has a third bead 117 (as in Figure 2), it does without the second bead 112 (refer to

Figure 10) because often the form-locking connection provided at the cable side end of the sleeve 11 is completely adequate.

The plug-in connectors shown in Figures 4 to 6 correspond to those of Figures 1 to 3 except that instead of the sleeve 11 a sleeve 12 is inserted which is shown in detail in the embodiment of Figures 4 to 6 and in Figure 11, and which only differs from the sleeve 11 in that the inner profile is adapted to suit a helically corrugated outer conductor 6b, see reference numerals 121a and 122 in Figure 11.

The three versions shown in Figures 7 to 9 of a plug-in connector according to the second embodiment are each provided for coaxial cables with helically corrugated outer conductors 6a and all their parts therefore correspond to the embodiments of the plug-in connector according to the first solution in Figures 4 to 6, with the one single difference that there is no clamping of the front end edge region of the outer conductor 6b. Therefore, no form-locking connection is sought between the outer annular peripheral surface of the front end of the outer conductor 6b and a tapered annular surface at the front end of the sleeve 12 which corresponds to the surface 111c in Figure 10. Instead of this, a tapered annular surface 121d (see Figure 11) is formed on the front edge of the bead 121 of the sleeve 12, the tapered annular surface 121d extending synchronously to the conical annular surface 1b at the base of the bore of the connector housing 1, and in such a way that when the hollow nut 2 is tightened not only is the rear end of the sleeve 12, at the cable side, compressed, but also the front region, on the plug-in side, is radially compressed.

So as mechanically to intercept the cable in a reliable way, a form-locking connection is necessary at least at one location between the sleeve 12 and the outer conductor 6b. This form-locking connection can be obtained by way of an inwardly projecting second bead 122, as in Figure 7, by a third bead 127 in the region of the cable side end of the sleeve 12, as in Figure 9, or by both beads 122 and 127 simultaneously, as in Figure 8.

The embodiments, illustrated in Figures 7 to 9, of the plug-in connector according to the second solution can be adapted to suit outer conductors with annular corrugations if the inner profile of the intercepting- and contacting sleeve is structured appropriately, as shown by the corresponding reference numerals of Figures 10 and 11.

CLAIMS

1. A plug-in connector for a coaxial cable with a corrugated tube outer conductor, the connector comprising a connector housing which has a bore to receive the outer conductor, the bore having at the periphery of its base a conical annular surface to contact an inner annular peripheral surface of the front end of the outer conductor; an intercepting- and contacting sleeve to embrace the outer conductor concentrically and having axial slits emanating from its front end edge on the plug-in side, with the front end edge of the intercepting- and contacting sleeve designed as a bead which projects at least radially inwardly and engages in a first corrugation trough of the outer conductor, has a conical clamping surface to rest on an outer annular peripheral surface of the front end of the outer conductor; and rests by way of its outer circumferential face on the inner wall of the bore of the connector housing, and a thrust member which can be screwed to the connector housing and which axially loads the rear end, on the cable side, of the sleeve, in which the sleeve has axial slits emanating from its rear end on the cable side, the slits being uniformly displaced circumferentially opposite the axial slits emanating from the front end edge of the sleeve, and, on the cable side, the sleeve has an end face which is in the form of a tapered annular surface and cooperates with a complementary tapered annular surface which is provided on the front edge of the thrust member radially to compress the rear end of the sleeve when the thrust member is tightened.

2. A plug-in connector according to claim 1, in which the predominant part of the sleeve is distanced by an annular gap from the inner wall of the bore of the connector housing, but that the sleeve has an annular collar on the outside approximately halfway along its length, by means of which annular collar it bears against the inner wall of the bore of the connector housing.

3. A plug-in connector according to claim 1 or claim 2, in which the axial slits emanating from the front end edge of the sleeve extend to a location in the vicinity of the end, on the cable side, of the

sleeve, and the axial slits which emanate from the end, on the cable side, of the sleeve extend to a location in the vicinity of the front end edge of the sleeve.

4. A plug-in connector according to one of claims 1 to 3, in which the thrust member comprises a thrust ring which supports the tapered conical surface and a screw member which form-lockingly receives the thrust ring, the screw member being in threaded engagement with the connector housing.

5. A plug-in connector according to one of claims 1 to 4, in which the inside of the sleeve has a second bead to engage into a second corrugation trough of the outer conductor.

6. A plug-in connector according to one of claims 1 to 5, in which in the region of its end at the cable side the inside of the sleeve has a third bead to engage into a corrugation trough of the outer conductor.

7. A plug-in connector for a coaxial cable with a corrugated tube outer conductor, the connector comprising a connector housing which has a bore to receive the outer conductor, the bore having at the periphery of its base a conical annular surface; an intercepting- and contacting sleeve to embrace the outer conductor concentrically and having axial slits emanating from its front end edge on the plug-in side, with the front end edge of the intercepting- and contacting sleeve designed as a bead which projects at least radially inwardly and engages in a first corrugation trough of the outer conductor and bears by way of its outer circumferential face on the inner wall of the bore of the connector housing; and a thrust member which can be screwed to the connector housing and which loads the rear end, on the cable side, of the sleeve axially, in which the conical annular face on the peripheral base of the bore of the connector housing is oriented in such a way that it cooperates with a complementary tapered annular face provided on the front edge of the bead of the sleeve to radially to compress the bead of the sleeve when the thrust member is tightened, the sleeve has axial slits emanating from its rear end on the cable side which are uniformly

displaced circumferentially opposite the axial slits emanating from the front end edge of the sleeve, and on the cable side, the sleeve has an end face which is designed as a tapered conical surface, and cooperates with a complementary tapered annular surface provided on the front edge of the thrust member to radially to compress the rear end of the sleeve when the thrust member is tightened.

8. A plug-in connector according to claim 7, in which the predominant part of the sleeve is distanced by an annular gap from the inner wall of the bore of the connector housing, but that the sleeve has an annular collar on the outside approximately halfway along its length, by means of which annular collar it bears against the inner wall of the bore of the connector housing.

9. A plug-in connector according to claim 7 or claim 8, in which the axial slits emanating from the front end edge of the sleeve extend to a location in the vicinity of the end, on the cable side, of the sleeve, and the axial slits which emanate from the end, on the cable side, of the sleeve extend to a location in the vicinity of the front end edge of the sleeve.

10. A plug-in connector according to any one of claims 7 to 9, in which the thrust member comprises a thrust ring which supports the tapered conical surface and a screw member which form-lockingly receives the thrust ring, the screw member being in threaded engagement with the connector housing.

11. A plug-in connection according to any one of claims 7 to 10, in which the inside of the sleeve has a second bead to engage into a second corrugation trough of the outer conductor.

12. A plug-in connector according to any one of claims 7 to 11, in which in the region of its end at the cable side the inside of the sleeve has a third bead to engage into a corrugation trough of the outer conductor.

13. A plug-in connector for a coaxial cable with a corrugated tube outer conductor substantially as hereinbefore described and illustrated with reference to the accompanying drawings.

Patents Act 1977 **CORRECTED**
Examiner's rep rt to the Comptroller under Section 17
(The Search report) -13-

Application number
GB 9404924.4

Relevant Technical Fields

(i) UK Cl (Ed.M) H2E (EDGB, EDGX, EGDA, EGDX, EEGA)

(ii) Int Cl (Ed.5) H01R

Search Examiner
F J FEE

Date of completion of Search
23 JUNE 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant following a search in respect of Claims :-
1-13

Categories of documents

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
A	GB 1531847* (ANDREW) Equivalent to the DE document mentioned in page 1	

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